EARLY PREDICTION OF LUNG METASTASES IN SOFT-TISSUE SARCOMAS OF THE EXTREMITIES USING JOINT FDG-PET AND MRI TEXTURAL FEATURES

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Introduction and Objectives: The specific and early evaluation of lung metastasis risk in the course of soft tissue sarcoma (STS) management is of great interest since it could potentially allow for better adapted treatments and consequently, improve overall survival. We hypothesize that intratumoral heterogeneity could be quantified using texture analysis of FDG-PET and MR images in order to assess tumour aggressiveness at the time of diagnosis. Towards this goal, this study first aims at developing a joint FDG-PET/MRI texture-based model for the evaluation of lung metastasis risk in soft-tissue sarcomas using retrospective analysis. We then assess the model performance using a new prospective STS cohort.

Methods: In this study, a total of 66 patients with histologically confirmed STSs of the extremities of different sub-types were divided into two groups: a retrospective cohort of 51 patients (19 patients developed lung metastases) with a median follow-up of 25 months (range: 4-70) used for training the model, and a prospective cohort of 15 patients (two patients developed lung metastases and one patient, bone metastases with suspicious lung nodules) with a median follow-up of 12 months (range: 4-19) for testing the model. All patients underwent pre-treatment FDG-PET and MRI scans that comprised T1-weighted and T2-weighted fat-suppression sequences. In the training phase, 41 different texture features (e.g., homogeneity, coarseness, etc.) were extracted from the tumor region of the FDG-PET and MRI scans. Multivariable models were constructed using logistic regression and were evaluated using the area under the receiver operating characteristic curve (AUC) in bootstrap resampling experiments. In the testing phase, the best model obtained from the training phase was applied to predict the distant metastasis development status of the prospective cohort.

Results: In the training phase, the best performance was found using a multivariable model with 4 texture features characterizing tumor sub-region size and intensity heterogeneities in FDG-PET and MRI scans. This model reached an average AUC of 0.984 ± 0.002 in 1000 bootstrap resampling experiments. In the testing phase (fig. 3), this model correctly predicted future distant metastasis development for 13 of the 15 patients, with a sensitivity of 1 and a specificity of 0.83.

Conclusion: Our results demonstrate that combinations of FDG-PET and MRI texture features could be successfully used to assess metastasis development risk at the moment of diagnosis of an extremity STS. The predictive properties of the model now need to be validated using a prospective multicenter study. Ultimately, accurate risk assessment could impact selection of treatment modalities and allow for better personalized treatments.

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Keywords : Lung metastasis; predictive tool; FDG-PET/MRI texture-based model; soft-tissue sarcoma

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